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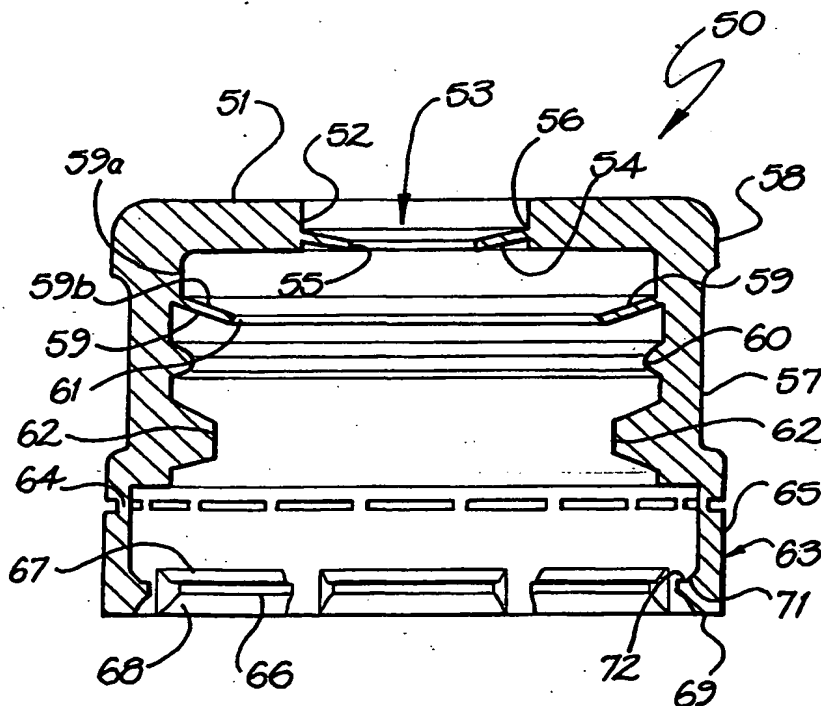
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(54) Title: CLOSURE WITH PUSH-PULL RESEALABLE CAP

(57) Abstract

A closure suitable for mounting onto a container. The closure includes a main closure having a top portion having an aperture therethrough and a skirt portion depending downwardly from the top portion and adapted to attach to the container. A spout extends upwardly from the top portion and defines a bore that is in fluid communication with the aperture in the top portion. A plug member having a radially outer surface is mounted to the spout and extends at least partially across the bore. A top cap is mounted to the spout and has an upper portion that has an inner surface defining an opening through the upper portion, the opening being in fluid communication with the bore of the spout. The top cap is relatively movable between a first position where the plug member is at least partially within the opening and at least a second position where the plug member is withdrawn from the opening. Prior to the plug member firstly entering the opening in the upper portion of the top cap, an annular sealing rib extends inwardly from the upper portion at least partially across the opening to a free edge. The inner surface of the opening has an internal diameter relative to the external diameter of the plug member such that when the plug member at least firstly enters the opening, at least a portion of the sealing rib is engaged by the plug member and folded back towards the inner surface of the opening to form a seal between at least the outer surface of the plug member and the top cap.



Prior to the plug member firstly entering the opening in the upper portion of the top cap, an annular sealing rib extends inwardly from the upper portion at least partially across the opening to a free edge. The inner surface of the opening has an internal diameter relative to the external diameter of the plug member such that when the plug member at least firstly enters the opening, at least a portion of the sealing rib is engaged by the plug member and folded back towards the inner surface of the opening to form a seal between at least the outer surface of the plug member and the top cap.

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"Closure with push-pull resealable cap"

Technical Field

5 The present invention relates to a closure for a container. More particularly, the invention relates to a resealable push-pull type closure that provides resealable access to the contents of a container.

Background Art

10 Resealable push-pull closures (or as they are sometimes called, "sports closures") allow a person to pour out a container's contents without the need to fully remove the closure from the container.

Such closures typically comprise a main cap that seals the container in the manner of normal closures as known in the art. The top surface of the main cap normally has an opening in fluid communication with the bore of a spout. The spout in turn has a plug member that partially blocks the bore. 15 To seal the container, a top cap, which also has an aperture, is mounted to the spout. The top cap is normally movable between at least a first position in which its aperture is sealed by the plug member so sealing the container and a second position in which the aperture is not sealed by the plug member so allowing the container's contents to exit from the container around the plug member and through the aperture of the top cap. 20

The top cap is generally mounted to the spout in a manner such that is readily movable between the first and second positions by only one hand or even by the teeth. This traditionally has made the closure popular with sportspersons, such as runners or cyclists, who may wish to consume a product but who may only have one hand free whilst participating in their sport. 25

The use of such a closure is, however, not restricted only to containers for sports drinks and they have found application in an ever wider range of container types and products in general use by consumers. For example, the closures have been used to seal containers containing beverages marketed at children. The closures are often easier to unseal than the traditional requirement of fully unscrewing a closure from the container. The smaller opening in the top cap also restricts the rate of flow of the beverage from the container making it easier for a child to consume the beverage without mess. 30

35 Containers for carbonated beverages must be sealed by closures that can withstand the increase in pressure created within the container by the

carbonation of the beverage. The closures must also retain a sufficient degree of sealing to prevent loss of gas from the container in the time between filling of the container and eventual consumption of the beverage by the consumer.

5 United States Patent specification 5,423,444 discloses a plastic closure for a container having an externally screw threaded neck that can be used for carbonated beverages.

10 The closure in US 5,423,444 has a top portion and an internally threaded skirt. An annular sealing rib also projects downwardly from the underside of the top portion. The rib includes a first substantially cylindrical portion contiguous with the underside of the top portion and lying adjacent to or abutting with the skirt, and a second, frusto-conical, portion contiguous with the end of the first portion distal to the underside of the top portion and extending radially inwardly to a circular free edge. During threaded
15 attachment of the closure with the neck, the second, frusto-conical, portion is engaged by a free end of the neck and folded back towards and preferably against the first portion of the rib to form a gas tight seal between at least the outer surface of the neck of the container and the closure.

20 United States Patent specification 5,609,263 discloses a closure having a sealing rib in which there is at the free end of the second portion of the rib a thick seal ring of substantially circular cross-sectional shape. The rib and the seal ring are dimensioned to engage the free end of the neck when the closure is threaded onto the neck such that when the neck is fully screwed into the closure its free end crushes the seal ring directly against the inside
25 surface of the top portion of the closure.

30 Australian Patent Application No 80944/98 discloses still further variants of the closure described in US 5,423,444. In one variant, the sealing rib of the closure has a third portion connected to the second portion at or adjacent its circular edge and extending generally in a direction away from the top portion. The third portion is substantially no thicker than the second portion and has a length longer than its thickness. On attachment of this
closure to a container, the third portion is positioned between the neck of the container and the underside of the top portion of the closure.

35 The present invention is directed to a resealable push-pull closure that is suitable for, but not limited to, sealing containers for carbonated beverages.

Disclosure of the Invention

According to a first aspect, the present invention relates to a closure suitable for mounting onto a container, the container having an end portion defining a container opening, the closure including:

5 a main closure having:

a top portion having an aperture therethrough;

a skirt portion depending downwardly from the top portion and adapted to attach to the container end portion;

10 a sealing means adapted, on attachment of the main closure to a container, to form a seal with the end portion of the container;

a spout extending upwardly from the top portion, the spout defining a bore that is in fluid communication with the aperture in the top portion; and

15 a plug member having a radially outer surface and mounted to the spout and extending at least partially across the bore; and

a top cap mounted to the spout, the top cap having an upper portion that has an inner surface defining an opening through the upper portion, the opening being in fluid communication with the bore of the spout, the top cap being relatively movable between a first position where the plug member is at least partially within the opening and at least a second position where the plug member is withdrawn from the opening;

20 wherein, prior to the plug member firstly entering the opening in the upper portion of the top cap, an annular sealing rib extends inwardly from the upper portion at least partially across the opening to a free edge, the inner surface of the opening having an internal diameter relative to the external diameter of the plug member such that when the plug member firstly enters the opening, at least a portion of the sealing rib is engaged by the plug member and folded back towards the inner surface of the opening to form a seal between at least the outer surface of the plug member and the top cap.

30 According to a second aspect, the present invention comprises a top cap for mounting to a spout of a main closure, the spout defining a bore and having a plug member extending at least partially across the bore, the top cap having an upper portion that has an inner surface defining an opening through the upper portion, and, prior to the mounting of the top cap to the spout, an annular sealing rib that extends inwardly from the upper portion at

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least partially across the opening to a free edge, the inner surface of the opening having an internal diameter relative to the external diameter of the plug member such that when the plug member firstly enters the opening on mounting of the top cap to the spout, at least a portion of the sealing rib is
5 engaged by the plug member and folded back towards the inner surface of the opening to form a seal between at least an outer surface of the plug member and the top cap.

Once the sealing rib of the top cap has been folded back towards the inner surface as the plug member firstly enters the opening in the upper
10 portion, the sealing rib will normally and preferably substantially retain this position during any subsequent movement of the top cap between its first position and second position.

In one embodiment, the inner surface of the opening in the upper portion of the top cap is substantially cylindrical and extends from an upper
15 side to an underside of the upper portion. In a preferred embodiment, the rib, prior to the plug member firstly entering the opening in the upper portion of the top cap, has at least a frusto-conical portion extending radially inwardly to a circular free edge. In this embodiment, the frusto-conical portion will preferably be engaged by the plug member and folded back
20 towards the inner surface when the plug member at least firstly enters the opening.

The sealing rib preferably extends inwardly from the inner surface of the upper portion of the top cap. The sealing rib even more preferably extends inwardly from a position on the inner surface adjacent the underside
25 of the upper portion. Where the rib includes or comprises a frusto-conical portion, the frusto-conical portion preferably does not extend below the underside of the upper portion. It will be appreciated that the frusto-conical portion could extend downwardly as far as or even below the underside of the upper portion in other embodiments. The thickness of the annular
30 sealing rib can be substantially constant along its length from the inner surface to its free edge. It will be appreciated that in another embodiment, the thickness of the sealing rib could vary along its length. For example, the thickness of the rib could taper in thickness towards its free edge.

Preferably, when the plug member at least firstly enters the opening in
35 the upper portion of the top cap, the sealing rib will be folded back against the inner surface of the upper portion. This will cause the sealing rib to bear

more strongly against at least the outside surface of the plug member and so form a better seal with at least the outside surface of the plug member.

5 In one embodiment, there can be at the line of meeting of the inner surface of the upper portion of the top cap and the sealing rib, a weakened zone or annular region of weakness to assist even deformation of the rib relative to the inner surface when the plug member firstly enters the opening.

10 In a further embodiment, the rib can include an additional portion connected to the inwardly extending portion at or adjacent the free edge and extending generally in a direction away from the upper portion to an end distal the upper portion. Where the sealing rib includes this additional portion, it preferably seals with the plug member from a position on the outer surface of the plug member to at least onto the apex of a free end of the plug member when the plug member at least firstly enters the opening in the upper portion of the top cap.

15 The additional portion of the sealing rib is preferably contiguous with the circular free edge of the inwardly extending portion, though it may be spaced slightly radially outwardly from it. The additional portion is preferably substantially no thicker than the inwardly extending portion and further preferably has a length longer than its thickness. The additional portion also preferably projects generally axially away from the upper portion of the top cap to its distal end. The additional portion is preferably substantially cylindrical and can have both a cylindrical inner surface and a cylindrical outer surface. The additional portion can join the inwardly extending portion in an angular disjunction or it may join it in a smooth angular transition from the generally radially inward direction of the inwardly extending portion to a generally axial direction.

20 The top cap preferably has a substantially cylindrical skirt portion depending downwardly from its upper portion. The skirt portion preferably extends downwardly at or adjacent the outer edge of the upper portion. An outside surface of the skirt portion adjacent the upper portion can have an annular protrusion extending radially outwardly from the outside surface.

30 The top cap preferably has a secondary sealing member adapted to seal with the spout. In one embodiment, the secondary sealing member can comprise an annular sealing liner positioned under the upper portion and adjacent the skirt portion of the top cap. Such a sealing liner would be

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sealable with a free end of the spout when the top cap was mounted to the spout.

In a more preferred embodiment, the top cap is linerless, with the secondary sealing member comprising an annular sealing rib adapted to seal with the spout.

The annular sealing rib comprising the secondary sealing member can project downwardly from an underside of the upper portion and include a first portion which is contiguous with the upper portion and has an inner surface, which inner surface lies radially inwardly of the skirt portion, and at least a second, frusto-conical, portion contiguous with the first portion and separated from the upper portion by the inner surface of the first portion, the second portion extending radially inwardly and downwardly to a circular edge. The inner surface of the first portion preferably has an internal diameter relative to the external diameter of the spout to which the top cap is to be attached such that during attachment of the top cap with the spout, the sealing rib will be engaged by the spout so folding the second portion towards at least the inner surface of the first portion of the rib to form a seal between at least an outer surface of the spout and the top cap.

In this embodiment, the seal can be formed only with the outer surface of the spout. In other embodiments, the seal may extend from the outer surface at least onto the outside radius of the spout. In a still further embodiment, the seal may extend from the outer surface, around the outside radius of the spout and onto the free end of the spout.

The inner surface of the first portion of the secondary sealing rib on the top cap is preferably substantially cylindrical. The first portion of the secondary sealing rib can comprise a thickening of the skirt portion in the region adjacent its connection to the upper portion. By comprising such a thickening, the root of the second portion of the secondary sealing rib is moved inwardly of the part of the skirt portion having the screw thread or other attachment means.

In another embodiment, the first portion of the secondary sealing rib on the top cap is formed radially inwardly of the skirt portion with an annular space therebetween. In a still further embodiment, the first portion of the secondary sealing rib can be in abutment with the skirt portion.

In yet a further embodiment, the first portion of the secondary sealing rib can have a thickness that increases as it extends in a direction away from

the upper portion of the top cap. The thickness of the first portion can increase at a uniform rate along the length of the first portion away from the upper portion, however, it could do so in a non-uniform manner. The increase in the thickness of the first portion means that the inside surface and, where there is one, the outside surface, of the first portion will each not necessarily be exactly cylindrical. They may respectively taper slightly inwardly and outwardly relative to the axis of the top cap in a direction away from the upper portion of the top cap.

The inner surface of the first portion serves to form an abutment towards which the second portion is folded during attachment of the top cap with the spout. Preferably, during attachment, the second portion will be folded back against the first portion such that it bears against the inner surface of the first portion.

There also can be at the line of meeting of the first and second portions of the secondary sealing rib of the top cap, a weakened zone or annular region of weakness to assist even deformation of the second portion relative to the first as the top cap is attached to the spout as is described in Australian patent specification 637706, the contents whereof are incorporated herein by reference.

In another embodiment, prior to the top cap being firstly mounted to the spout, the secondary annular sealing rib extends radially inwardly from an inside surface of the skirt portion of the top cap to a free edge. When the top cap is firstly mounted to the spout, at least a portion of the secondary rib is preferably engaged by at least the spout wall and folded back towards an inside surface of the skirt portion to form a secondary seal between at least the outer surface of the spout and the skirt portion of the top cap.

Once the secondary sealing rib has been folded back towards the inside surface of the skirt portion when the top cap is mounted to the spout, the secondary rib will preferably normally substantially retain this position during any subsequent movement of the top cap between its first position and second position. It is further preferred, that the secondary rib retains a seal with the outer surface of the spout when the top cap is in the first position, when in at least the second position and when being relatively moved between the first and at least second positions.

In one embodiment, the inside surface of the skirt portion of the top cap is substantially cylindrical. In a preferred embodiment, the secondary

sealing member comprises an annular sealing rib including at least a frusto-conical portion extending from an inner surface of the skirt portion radially inwardly and downwardly to a circular edge, the frusto-conical portion being positioned such that during attachment of the top cap with the spout, the
5 sealing rib will be engaged by the spout so folding the frusto-conical portion towards at least the inner surface of the skirt portion of the spout to form a seal between the spout and the top cap.

An annular bead can be disposed on the inside surface of the skirt portion of the top cap below the secondary sealing rib.

10 The thickness of the secondary sealing rib can be substantially constant along its length from the inside surface of the skirt portion to its free edge. It will be appreciated that in another embodiment, the thickness of the secondary sealing rib could vary along its length. For example, the thickness of the secondary rib could taper in thickness towards its free edge.

15 Where the secondary sealing rib is frusto-conical and extends inwardly from the inner surface of the skirt portion, the rib can be distal the underside of the upper portion of the top cap. In a further embodiment, the secondary sealing rib is positioned about midway between the underside of the upper portion and a free end of the skirt portion.

20 The inside surface of the skirt portion preferably has attachment means complementary to attachment means on an external surface of the spout. In one embodiment, the complementary attachment means can comprise a thread adapted to engage a corresponding thread on the external surface of the spout. Where the attachment means comprises a thread, a turn
25 of the top cap in one direction will preferably move the top cap from the first position to at least the second position and a turn in an opposite direction will move the top cap from the second position to at least the first position.

In one embodiment, the thread on the inside surface of the skirt portion of the top cap comprises two or more thread segments. Each of the
30 thread segments can be formed with two substantially planar and parallel end surfaces that are inclined to the axis of the top cap.

In one embodiment, the thread on the external surface of the spout is a recessed thread adapted to receive the complementary thread of the top cap. Where the thread on the inside surface of the skirt portion comprises a
35 number of thread segments, the recessed thread on the spout is preferably comprised of an equal number of recesses spaced to receive the thread

segments when the top cap is mounted to the spout. Each recess preferably includes an upwardly directed ramp member so located that on rotation of the top cap relative to the spout, the thread segments of the skirt portion enter the ramp member so moving the top cap relatively upwardly on the spout. The ramp member is preferably formed at an angle between 10 and 50 degrees, more preferably about 30 degrees, relative to a notional radial plane normal to the longitudinal axis of the spout. When the top cap is firstly mounted to the spout, the top cap can be preferably pushed onto the spout such that the thread of the top cap engages within the recessed thread on the external surface of the spout.

The top cap is preferably provided with a tamper evident band adapted to provide an indication of movement or attempted movement of the top cap from its first position at least towards its second position relative to the spout. The tamper evident band can extend from the skirt portion of the top cap, and preferably from the free edge of the skirt, by connection through a frangible connection, such as a plurality of frangible bridges.

The band can comprise a generally cylindrical body portion and an annular rib extending inwardly of the body portion and adapted to provide a lip having an inner free edge. When the top cap is firstly mounted to the spout, the lip engages under a retaining flange extending outwardly from the spout below the attachment means on the spout. The annular rib is preferably segmented, with the combined length of the segmented ribs being preferably equal to at least 50% of the internal circumference of the band. Each of the rib segments can be separated by a gap and be equally spaced about the body portion.

Each of the rib segments can each have an upper surface facing generally towards the upper portion of the top cap and an underside facing generally away from the upper portion. The underside can slope inwardly and upwardly from a free end of the body portion. The upper surface of each rib segment extending inwardly of the body portion can be a compound two-part surface comprising a first surface contiguous with the body portion of the band, which surface slopes inwardly and downwardly away from the upper portion, and a second surface which extends radially inwardly from the inner terminus of the first surface and has a slope angle substantially normal to the skirt portion of the top cap.

When the top cap is firstly mounted to the spout, the rib on the tamper evident band preferably rides over the retaining flange on the spout and locates therebeneath without damage to the frangible connection. When the top cap is moved from its first position towards at least its second position, the rib preferably engages with and is held under the retaining flange thereby causing breakage of the frangible connection.

In a preferred embodiment, the outer wall of the spout has a substantially cylindrical outer surface extending from a free end to the retaining flange. The outer wall of the spout can also have a cylindrical outer surface between the retaining flange and the top portion of the main closure. The external diameter of the outer wall between the flange and the top portion of the main closure can be greater than that of the outer wall of the spout extending downwardly from the free end to the flange. The outer wall can also have a substantially cylindrical inner surface defining a cylindrical bore therethrough. The bore is preferably centrally located within the spout. The spout is also preferably centrally located in the top portion of the main closure. If required, the external diameter of a region of the spout wall adjacent its free end can be stepped inwardly. This inwardly stepped region can be used when the secondary sealing member comprises an annular sealing rib projecting downwardly from an underside of the upper portion of the top cap.

The plug member is preferably centrally located in the bore of the spout, with an annular aperture between the plug member and the spout wall defining the bore. The annular aperture is preferably spanned by a plurality of bridge members that extend radially inwardly from the spout wall to support the plug member. In one embodiment, three equally spaced bridge members span the annular aperture to the plug member. Each bridge member in addition to extending inwardly can extend upwardly to the plug member.

The plug member preferably comprises a tube having a substantially cylindrical outer surface that is sealed at one end. The outer surface preferably extends upwardly beyond the extent of the free end of the spout wall such that the sealed end is distal the free end of the spout.

In one embodiment of the first aspect, the sealing means of the main closure can comprise an annular sealing liner positioned under the top portion and adjacent the skirt portion of the main closure.

In a more preferred embodiment, the main closure is linerless, with the sealing means comprising an annular sealing rib adapted to seal with the end portion of the container. The annular sealing rib of the main closure preferably projects downwardly from an underside of the top portion of the main closure and includes a first portion which is contiguous with the top portion and has an inner surface, which inner surface lies radially inwardly of the skirt portion, and at least a second, frusto-conical, portion contiguous with the first portion and separated from the top portion by the inner surface of the first portion, the second portion extending radially inwardly to a circular edge. The inner surface of the first portion preferably has an internal diameter relative to the external diameter of the end portion of the container to which the main closure is to be attached such that during attachment of the main closure with the end portion of the container, the sealing rib will be engaged by the end portion of the container so folding the second portion at least towards the inner surface of the first portion of the rib to form a seal between at least an outer surface of the end portion of the container and the main closure.

The end portion of the container to be sealed by the present invention preferably has a free end, an outside, preferably cylindrical, surface and an inside, preferably cylindrical, surface, the inside surface defining a bore. One of or both of the joins between the free end and the inside surface and between the free end and the outside surface can be smoothly curved and define respectively what are hereinafter called the inner and outer sealing radii of the end portion of the container.

The main closure is preferably provided with a screw thread on an inside surface of its skirt portion adapted to engage with a corresponding thread on an external surface of the end portion of the container. It is, however, possible for the container and the main closure to be formed with other complementary attachment means. Such an arrangement could, for instance, comprise snap-on attachment means having a rib on the inside surface of the main closure and a corresponding groove on the outside surface of the end portion of the container.

The inner surface of the first portion of the sealing rib on the main closure is preferably substantially cylindrical. The first portion of the rib can comprise a thickening of the skirt portion in the region adjacent its connection to the top portion. By comprising such a thickening, the root of

the second portion of the rib is moved inwardly of the part of the skirt portion having the screw thread or other attachment means.

5 In another embodiment, the first portion of the sealing rib on the main closure is formed radially inwardly of the skirt portion with an annular space therebetween. In a still further embodiment, the first portion of the sealing rib can be in abutment with the skirt portion.

10 In yet a further embodiment, the first portion of the rib can have a thickness that increases as it extends in a direction away from the top portion of the main closure. This thickening of the first portion serves to increase the force of the pressure of the rib against the outside surface of the end portion of the container on attachment of the main closure to the end portion. The thickness of the first portion can increase at a uniform rate along the length of the first portion away from the top portion, however, it could do so in a non-uniform manner. The increase in the thickness of the
15 first portion means that the inside surface and, where there is one, the outside surface, of the first portion will each not necessarily be exactly cylindrical. They may respectively taper slightly inwardly and outwardly relative to the axis of the main closure in a direction away from the top portion of the main closure.

20 The inner surface of the first portion serves to form an abutment towards which the second portion is folded during attachment of the main closure with the end portion of a container. Preferably, during attachment, the second portion will be folded back against the first portion such that it bears against the inner surface of the first portion. This will cause the
25 second portion to bear more strongly against at least the outside surface of the end portion of the container and so form a better seal with at least the outside surface of the end portion.

30 In a further embodiment, the second portion of the sealing rib of the main closure can have a substantially constant thickness. In another embodiment, the second portion can taper in thickness towards its free edge.

35 In a still further embodiment, the sealing rib of the main closure can include a third portion connected to the second portion at or adjacent the circular edge of the second portion and extending generally in a direction away from the top portion. The third portion is preferably substantially no thicker than the second portion and further preferably has a length longer than its thickness. The third portion of the sealing rib is preferably

contiguous with the circular edge of the second portion, though it may be spaced slightly radially outwardly from it. The third portion also preferably projects generally axially away from the top portion of the main closure to its distal end. The third portion is preferably substantially cylindrical and can have both a cylindrical inner surface and a cylindrical outer surface. The third portion can join the second portion in an angular disjunction or it may join it in a smooth angular transition from the generally radially inward direction of the second portion to a generally axial direction. In this embodiment, on attachment of the main closure to the end portion of the container, the third portion preferably seals with the end portion from a position on the outside surface of the end portion to at least the apex of the free end of the end portion.

The closure according to the present invention may be made of any suitable synthetic plastics material, however it is preferred that it is formed from a suitable grade of polyethylene or polypropylene. The top cap may be formed from a different plastics material to that of the remainder of the closure. The sealing rib of the main closure is preferably formed integrally with its top portion, however, it can be envisaged in another embodiment that at least the sealing rib is formed separately from the main closure and inserted therein.

It will be apparent to persons skilled in the art that numerous modifications may be made to the main closure described in this specification without departing from the scope of the invention as earlier defined. The main closure may, for instance, be provided with a tamper evident band adapted to provide an indication of removal or attempted removal of the main closure from a container. The tamper evident band can extend from the skirt portion by connection through a frangible connection, such as a plurality of frangible bridges. Each bridge can be angled relative to the axis of the closure. The band can have a generally cylindrical body portion and a segmented rib extending inwardly of the body portion and adapted to provide a lip having an inner free edge to engage under a retaining flange extending outwardly from the end portion of the container. In one embodiment, below each rib segment and extending inwardly of the body portion there can be a radially inward projection that extends from proximate the free end of the band to the rib segments. In a preferred embodiment, each rib segment has a corresponding radially inward projection. In this

embodiment, each radially inward projection can abut its corresponding rib segment preferably about midway along each segment.

As is described in Australian patent specifications 668197, the contents whereof are incorporated herein by reference, the combined length of the segmented ribs on the band can be equal to at least 50% of the internal circumference of the band. Each of the rib segments can be equally spaced about the internal circumference of the band and separated from each other by a gap. Each of the rib segments can each have an upper surface facing generally towards the top portion of the main closure and an underside facing generally away from the top portion, with the inner surface of the band having a plurality of radially inward projections extending from above the free edge of the band and not extending beyond the inner free edge of the lip.

As is described in Australian patent specification 683598, the contents whereof are incorporated herein by reference, the upper surface of each rib segment extending inwardly of the body portion can comprise compound two-part surface having a first surface contiguous with the body portion of the band, which surface slopes inwardly and downwardly away from the top portion, and a second surface which extends radially inwardly from the inner terminus of the first surface and has a slope angle substantially normal to the skirt portion of the closure.

As is described in US 5,676,269, the contents whereof are incorporated herein by reference, the tamper evident band can be joined to the skirt portion of the main closure by a plurality of frangible bridges and at least one non-frangible bridge. The band can further have a substantially L-shaped slot extending through the side wall of the band, the horizontal leg of which terminates directly adjacent to or under the non-frangible bridge, and a weakened frangible region extending from the terminating end of the horizontal leg axially downwardly to the bottom of the band distal the frangible bridges.

Where the main closure has a screw thread on the inner surface of its skirt portion, the thread can be continuous or formed of a series of thread segments. If formed from a series of thread segments, the thread segments can be arranged, starting from a first thread segment distal to the top, along a helical thread locus, as is described in Australian patent specification 668197. Each of the thread segments except the first can be formed with two

substantially planar end surfaces that are inclined to the axis of the closure and face away from the top of the closure, that is they face in the direction that a mould core used to mould the closure was withdrawn. In this specification, the term "substantially planar surface" is used to describe a surface that is nearly actually planar or that is curved provided that it all faces in the defined direction. The first of the thread segments is preferably pointed at its end distal to its one adjacent thread segment to assist in mating the thread on the main closure with a complementary thread on the neck of a container.

The substantially planar ends of the thread segments can also be inclined to a notional radial plane of the main closure extending from the longitudinal axis of the main closure to the end of the respective thread segment such that the ends are inclined to the cylindrical skirt by an angle that is less than the angle that the respective notional plane makes with that skirt.

To assist in the venting of gas that may be present in the container, the spaces between the thread segments in adjacent turns of the thread can be aligned. A groove may also be provided on the inside surface of the skirt of the main closure extending longitudinally thereof through the aligned spaces.

There also can be at the line of meeting of the first and second portions of the sealing rib of the main closure, a weakened zone or annular region of weakness to assist even deformation of the second portion relative to the first as the main closure is attached to a container as is described in Australian patent specification 637706, the contents whereof are incorporated herein by reference.

Where the main closure has an annular sealing rib comprising a first portion and at least a second, frusto-conical, portion, the underside of the top portion of the main closure can also have an engagement means comprising a continuous or segmented annular ridge positioned radially inward of the sealing rib. The upper side of the second portion of the rib may also be formed with a complementary engagement means comprising a continuous or segmented annular ridge as is described in US 5,782,369, the contents whereof are incorporated herein by reference. On attachment of the main closure with the end portion, the engagement means on the second portion engage with the underside of the top portion. Where the underside of the top portion has the complementary engagement means, the respective

complementary engagement means preferably can be adapted to interlock as the main closure is attached to the container thereby holding the sealing rib touching the underside of the top portion stationary and causing the second portion of the sealing rib to be disposed over a still greater area of the underside of the top portion as well as the outside surface of the end portion.

In a further aspect, the present invention comprises a container sealed by a closure as defined herein.

In yet a further aspect, the present invention comprises a method of sealing a container comprising the step of mounting a closure according to the first aspect of the invention to the neck of the container.

In still yet a further aspect, the present invention comprises a mould for forming a main closure as defined herein. In a still further aspect, the present invention comprises a mould for forming the top cap as defined herein. The main closure and/or top cap can be formed using injection or rotary moulding. It will be appreciated by persons skilled in the art that other suitable techniques for forming the main closure and top cap could also be utilised.

Brief Description of Drawings

The following description of a preferred embodiment of the present invention is provided as an example of the invention and is described with reference to the accompanying drawings, in which:-

Fig. 1a is a sectional view through a main closure of a closure according to the first aspect of the present invention depicted above the free end of a container to be sealed by the closure;

Fig. 1b is a sectional view along line I-I of Fig. 1a;

Fig. 2a is an enlarged side elevational view of the spout of the main closure depicted in Fig. 1a;

Fig. 2b is a representation of the thread recesses of the spout of Fig. 2a;

Fig. 3a is a cross-sectional view of the top cap shown before being mounted to the spout of the main closure depicted in Fig. 1a; and

Fig. 3b is a representation of the thread segments on the inside surface of the skirt of the top cap depicted in Fig. 3a.

Best Mode of Carrying Out the Invention

The closure according to the present invention when put together comprises the main closure 10 depicted in Fig. 1a and the top cap 50 depicted in Fig. 3a.

An example of a bottle 80 to be sealed by the closure according to the present invention is formed from polyethylene terephthalate (PET) and is for a carbonated beverage (see Fig. 1a). The end portion 81 of the bottle 80 has a free end 82, an outside cylindrical surface 83 and an inside cylindrical surface 84, with the inside surface 84 defining a bore 85. The join between the free end 82 and the inside surface 84 and the join between the free end 82 and the outside surface 83 are each smoothly curved and define respectively inner and outer sealing radii 86, 87 of the end portion 81 of the bottle 80. While the present closure can seal bottles 80 having the end portion 81 as depicted in Fig. 1a, it will be readily appreciated that the closure can seal bottles having different end portion configurations, such as no outer or inner sealing radii, or only one of the outer or inner sealing radii.

The main closure 10 comprises a circular top 11 and a depending skirt 12. The radially inside surface of the skirt 12 is provided with a screw thread 13 that is adapted to mate with a corresponding thread on the neck of a bottle 80 to which the main closure 10 is adapted to be attached. While the embodiment of the main closure depicted in Fig. 1a has a continuous screw thread 13, it will be appreciated by persons skilled in the art that the thread could comprise a number of thread segments extending along a helical locus on the inside surface of the skirt 12. Other suitable means for attaching the main closure 10 to the bottle would also be immediately apparent to a person skilled in the art.

The radially outside surface of the skirt 12 carries a series of fine vertical ribs 14. The fine ribs 14 in the depicted embodiment terminate at the lower edge of the skirt 12 in a narrow circumferential rib 15.

A sealing rib 16 is provided on the underside of the top 11 of the main closure 10. The rib 16 is continuous and annular. Seen in cross-section the rib 16 has a first portion 17 and a second, frusto-conical, portion 18. The first portion 17 is contiguous with the top 11 and is spaced radially inwardly from the skirt 12. While depicted spaced radially inwardly from the skirt 12, it will be appreciated that in other embodiments, the first portion 17 could be positioned such that it abuts the skirt 12 or it could comprise a thickening of the skirt portion 12 adjacent the top 11. The inner surface 19 of the first portion 17 is substantially cylindrical, while the second portion 18 is of substantially constant thickness as it extends radially inwardly from its outer edge which is contiguous with the lower end of the first portion 17. While

depicted as being of substantially constant thickness, it will be appreciated by a person skilled in the art that the second portion 18 could taper slightly in thickness as it extends radially inwardly from its outer edge. A sharp edge 21 is formed between the first portion 17 and the second portion 18. This sharp edge 21 defines a line of weakness between the two portions 17,18 for a purpose that will be described later in this specification.

The second portion 18 of the rib 16 also has formed on its upper surface and proximate its free edge, a continuous annular ridge 22. The underside of the top 11 has formed on its surface inwardly of the first portion 17 a continuous annular ridge 23. When the main closure 10 is mounted to and turned relatively on to the end portion 81 of the bottle 80, the second portion 18 contacts the free end 82 of the bottle 80 and is caused to fold up towards and, in this embodiment, against the inner surface 19 of the first portion 17. As the main closure 10 is further relatively turned on to the end portion 81, contact is made between the underside of the top 11 and the ridge 22 on rib 16 and between the ridge 23 and the upper surface of the second portion 18.

Upon still further relative turning on of the main closure 10 to the end portion 81, the ridge 22 abuts with the ridge 23 thereby ensuring the second portion 18 is wedged between the free end 82 of the bottle 80 and the underside of the top 11, ie. the movement attaching the main closure 10 tends to pinch the second portion 18 of the rib 16 between the free end 82 of the bottle 80 and the underside of the top 11. This in turn pulls the second portion 18 tightly in towards the outer sealing radius 87 and the cylindrical outer surface 83 of the end portion 81 to produce a tight seal that extends from the free end 82 around the outer sealing radius 87 and down onto at least the outer surface 83 of the end portion 81 of the bottle 80.

Attached to the free end of the skirt 12 of the main closure 10 is a tamper evident band 24 that is adapted to provide an indication of removal or attempted removal of the main closure 10 from the bottle 80. The tamper evident band 24 is connected to the skirt 12 by a plurality of frangible bridges 25 spaced about the circumference of the free edge of the skirt 12.

The band 24 has a cylindrical body portion 26 and a plurality of spaced rib segments 27 that extend inwardly of the body portion 26 and which are adapted to provide a lip having an inner free edge to engage under a retaining flange extending outwardly from the end portion 81 of the bottle 80 below

the screw thread thereon. Below each rib segment 27 and extending inwardly of the body portion 26 is a radially inwardly extending projection 28 that extends from the free end of the body portion 26 to a position about midway along each rib segment 27.

5 The upper surface of each rib segment 27 extending inwardly of the body portion 26 can comprise a first surface 29 contiguous with the body portion 26 of the band 24, which surface slopes inwardly and downwardly away from the top portion 11, and a second surface 31 which extends radially inwardly from the inner terminus of the first surface 29 and has a slope angle
10 substantially normal to the skirt 12 of the main closure 10.

On attachment to the end portion 81 of the bottle 80, the inward projections 28 allow the rib segments 27 to ride out and over the retaining flange on the end portion 81 of the bottle 80 without damaging the frangible bridges 25. When the main closure 10 is removed from the bottle 80, the rib
15 segments 27 catch underneath the retaining flange on the bottle 80 so leading to breakage of the frangible bridges 25. The band 24 is thereby retained on the end portion 81 of the bottle 80. Breakage of the bridges 25 provides an indication to a consumer that the main closure 10 has been previously removed from the bottle 80.

20 The top 11 has a centrally located aperture 32 therethrough and a spout 33 extending upwardly from the top 11. The spout 33 has a wall 34 defining a bore 35 that is in fluid communication with the aperture 32 in the top 11.

25 The wall 34 of the spout 33 has a substantially cylindrical outer surface 37 extending from its free end 38 to the retaining flange 39. The wall 34 of the spout 33 can also have a cylindrical outer surface 40 between the retaining flange 39 and the upper side of the top 11 of the main closure 10. The external diameter of the outer wall 40 between the flange 39 and the top 11 is greater than that of the outer wall 34 of the spout 33 extending
30 downwardly from the free end 38.

35 A plug 36 is mounted to the spout 33 and is centrally located in the bore 35, with an annular aperture 41 between the plug 36 and the spout 33. The annular aperture 41 is spanned by a three equally spaced bridge members 42 that extend radially inwardly from the spout 33 to support the plug 36 to the spout 33. The plug 36 comprises a tube having a substantially cylindrical outer surface that extends upwardly beyond the extent of the free

end 38 of the spout 33 and has a sealed end 43 that is distal the free end 38 of the spout 33.

The top cap 50 that is mountable to the spout 33 has an upper portion 51 that has a cylindrical inner surface 52 defining an opening 53 through the upper portion 51. The opening 53 is adapted to relatively receive the plug 36 on spout 33 and is further described below. Prior to the plug 36 firstly relatively entering the opening 53 from beneath on mounting of the top cap 50 to the spout 33 and adopting a first position relative to the spout 33, a sealing rib 54 extends radially inwardly from the inner surface 52. The rib 54 is frusto-conical in form, substantially of constant thickness and extends radially inwardly to a circular free edge 55. At the line of meeting of the inner surface 52 and the sealing rib 54, a sharp edge 56 is formed that defines a line of weakness between the inner surface 52 and the rib 54. The sharp edge 56 assists even deformation of the rib 54 relative to the inner surface 52 when the plug 36 firstly relatively enters the opening 53 from beneath and then folds back the sealing rib 54 towards and, in this embodiment, against the inner surface 52. By being folded back against the inner surface 52, the sealing rib 54 bears strongly against at least the outside surface of the plug 36 and so forms a gas-tight seal between the top cap 50 and the plug 36 when the plug 36 is within the opening 53.

Once the sealing rib 54 has been folded back towards the inner surface 52 as the plug 36 firstly relatively enters the opening 53, the sealing rib 54 will normally substantially retain this position during any subsequent movement, including longitudinal movement or rotational movement, of the top cap 50 relative to the spout 33.

The top cap 50 has a skirt 57 depending downwardly from its upper portion 51. An outside surface of the skirt 57 adjacent the upper portion 51 has an annular protrusion 58 extending radially outwardly therefrom that assists a user in manipulation of the top cap 50 on the spout 33.

The top cap 50 also has a secondary sealing rib 59. In Fig. 3a, the secondary sealing rib 59 is depicted in the position it would take prior to the attachment of the top cap 50 to the spout 33. The rib 59 has a first or root portion 59a that is contiguous with the skirt 57 and a second, frusto-conical, portion 59b that is contiguous with the first portion 59a and extends radially inwardly and downwardly to a free edge 61. The first portion 59a has a substantially cylindrical inner surface while the frusto-conical portion 59b is

substantially of constant thickness along its length. When the top cap 50 is firstly mounted to the spout 33, the second frusto-conical portion 59b is engaged by the free end 38 of the spout 33 and folded back towards and preferably against the inner cylindrical surface of the first portion 59a to form a secondary seal between the spout 33 and the top cap 50.

It will be appreciated that the distance of the second portion 59b from the upper portion 51 of the top cap 50 and the length of the second portion 59b will govern the overall position of the seal formed between the secondary sealing rib 59 and the spout 33. If the second portion 59b is positioned closer to the underside of the upper portion than that depicted in Fig. 3a, then the second portion 59b may not be folded back against the first portion 59a but instead will be pinched between the free end 38 of the spout 33 and the underside of the upper portion 51. In an alternative arrangement, the distance between the underside of the upper portion 51 and the second portion 59b may be such that the second portion 59b is folded back against the inner surface of the skirt portion 57 and only forms a seal with the outer surface 37 of the spout 33.

In the embodiment depicted in Fig. 3a, the second portion 59b is of a length that it will be folded back towards and preferably against the cylindrical inner surface of the first portion 59a and the region comprising the join between the underside of the upper portion 51 and the inside surface of the skirt 57. This serves to extend the seal from the outer radius of the spout 33 (ie the region extending between its free end 28 and its cylindrical outer surface 37) and preferably onto its outer cylindrical surface 37. It will be appreciated that the second portion 59b could be extended compared to that depicted in Fig. 3a such that when folded back towards the inner surface of the first portion 59a, the seal would extend from at least the outer surface of the spout 33, around the outside radius of the spout and onto the free end 38 of the spout 33. The presence of the sealing rib 59 serves to ensure no loss of seal between the spout 33 and the skirt 57 of the top cap 50.

Once the secondary sealing-rib 59 has been folded back when the top cap 50 is mounted to the plug 36, the rib 59 will normally substantially retain this position during any subsequent movement, including longitudinal and rotational movement, of the top cap 50 relative to the spout 33.

Also disposed on the inside cylindrical surface of the skirt 57 is an annular bead 60. The bead 60 is adapted to contact the wall 34 of the spout

33 when the top cap 50 is mounted to the spout 33 even when the top cap has been relatively moved from its first position to a second position where the plug 36 is withdrawn from the opening 53. The bead 60 serves to help prevent the bottle's contents, such as a carbonated beverage, from leaking
5 down the side of the spout 33 between the spout 33 and the top cap 50 even when the top cap 50 is moved to its second position. The bead 60 is, however, not adapted to provide a seal for the container.

The inside cylindrical surface of the skirt 57 has two thread segments 62 formed with substantially planar and parallel end surfaces 62a that are
10 inclined to the axis of the top cap 50. The thread segments 62 are adapted to engage two complementary thread recesses 44 in the wall 34 when the top cap 50 is mounted to the spout 33.

Each thread recess 44 includes an upwardly directed ramp member 45 and a holding area 46. The ramp members 45 are so located that on rotation
15 of the top cap 50 relative to the spout 33, the thread segments 62 enter and move up the respective ramp members 45 so moving the top cap 50 relatively upwardly on the spout 33. The relative upward movement of the top cap 50 serves to disengage the plug 36 from opening 53 in the upper portion 51 of the top cap 50. Rotation of the top cap 50 in the opposite direction returns
20 the thread segments 62 down the respective ramp members 45 and into the holding areas 46.

The respective ramp members 45 are formed at an angle of about 30 degrees relative to a notional radial plane normal to the skirt 57 of the top cap 50. When the top cap 50 is firstly mounted to the spout 33, the top cap
25 50 is pushed relatively downwardly onto the spout 33 such that the thread segments 62 engage within the thread recesses 44 on the spout 33.

The top cap 50 is provided with a tamper evident band 63 that provides an indication of movement or attempted movement of the top cap 50 relative to the spout 33 after the top cap 50 has been mounted on the
30 spout 33. The tamper evident band 63 is connected to the skirt 57 by a plurality of frangible bridges 64.

The band 63 comprises a generally cylindrical body portion 65 and a plurality of rib segments 66 that extend inwardly of the body portion 65 and provide a lip having an inner free edge. The rib segments 66 are equally
35 spaced about the body portion 65 and constitute greater than 50% of the internal circumference of the body portion 65.

Each of the rib segments 66 have an upper surface 67 facing generally towards the upper portion 51 of the top cap 50 and an underside 68 facing generally away from the upper portion 51. The underside 68 slopes inwardly and upwardly from a free end 69 of the body portion 65. The upper surface 67 of each rib segment 66 comprises a first surface 71 contiguous with the body portion 65, which surface slopes inwardly and downwardly away from the upper portion 51, and a second surface 72 which extends radially inwardly from the inner terminus of the first surface 71 and has a slope angle substantially normal to the skirt 57.

When the top cap 50 is firstly mounted to the spout 33, the underside 68 of each rib segment 66 helps the rib segments 66 to ride over the retaining flange 39 on the spout 33 and locate therebeneath without damaging the frangible bridges 64. When the top cap 50 is then rotated relative to the spout 33 to move the opening 53 relatively clear of the plug 36, the rib segments 66 engage with and are held under the retaining flange 39 thereby causing breakage of the frangible bridges 64. While counter-rotation of the top cap 50 will move the top cap 50 relatively back down the spout 33, the breakage of the bridges 64 serves to indicate to the consumer of the bottle's contents that the top cap 50 has been previously unsealed from the plug 36.

A further overcap can be provided to attach over the top cap of the closure. The overcap acts to protect and keep clean the top cap 50 while the closure 10 is sealed to the bottle 80. A shrink wrap plastic sheet can also be applied about the bottle 80 and the closure once the closure is sealed to the bottle 80 to protect and keep clean the top cap 50.

The main closure 10 and top cap 50 can be fabricated from polyethylene by injection moulding. Other suitable materials and fabrication techniques can be readily envisaged.

The main closure 10 and top cap 50 will normally be moulded separately in appropriate moulds before the top cap 50 is mounted to the spout 33. At mounting, the sealing ribs 54 and 59 will be folded back and seal respectively with the plug 36 and spout 33, the thread segments 62 also engage within the thread recesses 44, and the rib segments 66 engage beneath the retaining flange 39. The bottle 80 is filled with a carbonated beverage before the entire closure is turned onto the end portion 81 so forcing the rib segments 27 on band 24 of the main closure 10 over the retaining flange on the end portion 81 of the bottle 80. As the main closure 10 is turned onto the

end portion 81, the second portion 18 of the sealing rib 16 is also folded back and seals with at least the outer surface 83 of the end portion 81 of the bottle 80. The closure has then sealed the bottle 80.

To access the carbonated beverage, the consumer has two choices.

5 Firstly, they can choose to remove the entire closure by simply unscrewing the main closure 10 from the end portion 81 so breaking the frangible bridges 25. Alternatively, the consumer can choose to turn the top cap 50 so relatively disengaging the plug 36 from the opening 53 and breaking the
10 frangible bridges 64. The beverage can then be poured through the spout 33 and exit the bottle 80 through the annular aperture 41 and opening 53, with leakage of the beverage between the spout 33 and inside surface of the skirt 57 prevented or at least substantially prevented by the annular bead 60. If the consumer wishes to reseal the bottle 80, the top cap 50 is counter-rotated returning the plug 36 into the opening 53 and into abutment with the sealing
15 rib 54.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to
20 be considered in all respects as illustrative and not restrictive.

CLAIMS:

1. A closure suitable for mounting onto a container, the container having an end portion defining a container opening, the closure including:

a main closure having:

5 a top portion having an aperture therethrough;

a skirt portion depending downwardly from the top portion and adapted to attach to the container end portion;

a sealing means adapted, on attachment of the main closure to a container, to form a seal with the end portion of the container;

10 a spout extending upwardly from the top portion, the spout defining a bore that is in fluid communication with the aperture in the top portion; and

a plug member having a radially outer surface and mounted to the spout and extending at least partially across the bore; and

15 a top cap mounted to the spout, the top cap having an upper portion that has an inner surface defining an opening through the upper portion, the opening being in fluid communication with the bore of the spout, the top cap being relatively movable between a first position where the plug member is at least partially within the opening and at least a second position where the
20 plug member is withdrawn from the opening;

wherein, prior to the plug member firstly entering the opening in the upper portion of the top cap, an annular sealing rib extends inwardly from the upper portion at least partially across the opening to a free edge, the inner surface of the opening having an internal diameter relative to the
25 external diameter of the plug member such that when the plug member firstly enters the opening, at least a portion of the sealing rib is engaged by the plug member and folded back towards the inner surface of the opening to form a seal between at least the outer surface of the plug member and the top cap.

30 2. The closure of claim 1 wherein the inner surface of the opening in the upper portion of the top cap is substantially cylindrical and extends from an upper side to an underside of the upper portion.

3. The closure of claim 2 wherein the annular sealing rib, prior to the plug member firstly entering the opening in the upper portion of the top cap,
35 has at least a frusto-conical portion extending radially inwardly to a circular free edge.

4. The closure of claim 2 or claim 3 wherein the sealing rib extends inwardly from the inner surface of the upper portion of the top cap adjacent the underside of the upper portion.

5. The closure of any one of the preceding claims wherein the thickness of the annular sealing rib is substantially constant along its length from the inner surface to its free edge.

6. The closure of claim 4 wherein there is, at the line of meeting of the inner surface of the upper portion and the sealing rib, a weakened zone or annular region of weakness to assist even deformation of the sealing rib relative to the inner surface when the plug member firstly enters the opening.

7. The closure of any one of the preceding claims wherein the rib includes an additional portion connected to the inwardly extending portion at or adjacent the free edge and extending generally in a direction away from the upper portion of the top cap to an end distal the upper portion.

8. The closure of claim 7 wherein the additional portion of the sealing rib is contiguous with the circular free edge of the inwardly extending portion.

9. The closure of claim 7 or claim 8 wherein the additional portion is substantially no thicker than the inwardly extending portion and has a length longer than its thickness.

10. The closure of any one of the preceding claims wherein the top cap has a substantially cylindrical skirt portion depending downwardly from its upper portion.

11. The closure of claim 10 wherein the top cap has a secondary sealing member adapted to seal with the spout.

12. The closure of claim 11 wherein the secondary sealing member comprises an annular sealing rib adapted to seal with the spout, the annular sealing rib projecting downwardly from an underside of the upper portion and including a first portion which is contiguous with the upper portion and has an inner surface, which inner surface lies radially inwardly of the skirt portion, and at least a second, frusto-conical, portion contiguous with the first portion and separated from the upper portion by the inner surface of the first portion, the second portion extending radially inwardly and downwardly to a circular free edge.

13. The closure of claim 12 wherein the first portion of the secondary sealing rib comprises a thickening of the skirt portion in the region adjacent its connection to the upper portion.

14. The closure of claim 11 wherein the secondary sealing member comprises an annular sealing rib including at least a frusto-conical portion extending from an inner surface of the skirt portion radially inwardly and downwardly to a circular edge.

5 15. The closure of claim 12 wherein an annular bead is disposed on the inside surface of the skirt portion below the secondary sealing rib.

16. The closure of any one of the preceding claims wherein the inside surface of the skirt portion has attachment means complementary to attachment means on an external surface of the spout.

10 17. The closure of claim 16 wherein the complementary attachment means comprises a thread adapted to engage a corresponding thread on the external surface of the spout.

18. The closure of claim 17 wherein the thread on the inside surface of the skirt portion of the top cap comprises two or more thread segments, each of the thread segments being formed with two substantially planar and parallel end surfaces that are inclined to the axis of the top cap.

15 19. The closure of claim 17 or claim 18 wherein the thread on the external surface of the spout is a recessed thread adapted to receive the complementary thread of the top cap.

20 20. The closure of claim 19 wherein each recess includes an upwardly directed ramp member so located that on rotation of the top cap relative to the spout, the thread segments of the skirt portion enter the ramp member so moving the top cap relatively upwardly on the spout.

21. The closure of claim 20 wherein the ramp member is formed at an angle between 10 and 50 degrees, more preferably about 30 degrees, relative to a notional radial plane normal to the longitudinal axis of the spout.

25 22. The closure of any one of the preceding claims wherein the top cap is provided with a tamper evident band adapted to provide an indication of movement or attempted movement of the top cap from its first position at least towards its second position.

30 23. The closure of claim 22 wherein the tamper evident band extends from the free edge of the skirt portion by connection through a plurality of frangible bridges.

35 24. The closure of claim 22 or claim 23 wherein the band comprises a generally cylindrical body portion and an annular rib extending inwardly of the body portion and adapted to provide a lip having an inner free edge.

25. The closure of claim 24 wherein the annular rib is segmented, with the combined length of the segmented ribs being equal to at least 50% of the internal circumference of the band.

26. The closure of claim 25 wherein each of the rib segments have an upper surface facing generally towards the upper portion of the top cap and an underside facing generally away from the upper portion, the upper surface of each rib segment extending inwardly of the body portion and comprising a first surface contiguous with the body portion of the band, which surface slopes inwardly and downwardly away from the upper portion, and a second surface which extends radially inwardly from the inner terminus of the first surface and has a slope angle substantially normal to the skirt portion of the top cap.

27. The closure of any one of the preceding claims wherein the plug member is centrally located in the bore of the spout, with an annular aperture between the plug member and the spout wall, the annular aperture being spanned by a plurality of bridge members that extend radially inwardly from the spout to support the plug member.

28. The closure of any one of the preceding claims wherein the plug member comprises a tube having a substantially cylindrical outer surface that is sealed at one end, the outer surface extending upwardly beyond the extent of the free end of the spout wall such that the sealed end is distal the free end of the spout.

29. The closure of any one of the preceding claims wherein the sealing means of the main closure comprises an annular sealing rib adapted to seal with the end portion of the container, the sealing rib projecting downwardly from an underside of the top portion and including a first portion which is contiguous with the top portion and has an inner surface, which inner surface lies radially inwardly of the skirt portion, and at least a second, frusto-conical, portion contiguous with the first portion and separated from the top portion by the inner surface of the first portion, the second portion extending radially inwardly to a circular edge, the inner surface of the first portion having an internal diameter relative to the external diameter of the end portion of the container to which the main closure is to be attached such that during attachment of the main closure with the end portion of the container, the sealing rib will be engaged by the end portion of the container so folding the second portion at least towards the inner surface of the first

portion of the rib to form a seal between at least an outer surface of the end portion of the container and the main closure.

30. The closure of any one of the preceding claims wherein the main closure is provided with a screw thread on an inside surface of its skirt portion adapted to engage with a corresponding thread on an external surface of the end portion of the container.

31. The closure of any one of the preceding claims wherein the main closure has a tamper evident band adapted to provide an indication of removal or attempted removal of the main closure from a container.

32. A container sealed by a closure as defined in any one of the preceding claims.

33. A method of sealing a container comprising the step of mounting a closure according to any one of claims 1 to 31 to the neck of the container.

34. A mould for forming a main closure as defined in any one of claims 1 to 31.

35. A top cap for mounting to a spout of a main closure, the spout defining a bore and having a plug member extending at least partially across the bore, the top cap having an upper portion that has an inner surface defining an opening through the upper portion, and, prior to the mounting of the top cap to the spout, an annular sealing rib that extends inwardly from the upper portion at least partially across the opening to a free edge, the inner surface of the opening having an internal diameter relative to the external diameter of the plug member such that when the plug member firstly enters the opening on mounting of the top cap to the spout, at least a portion of the sealing rib is engaged by the plug member and folded back towards the inner surface of the opening to form a seal between at least an outer surface of the plug member and the top cap.

36. A mould for forming the top cap as defined in claim 35.

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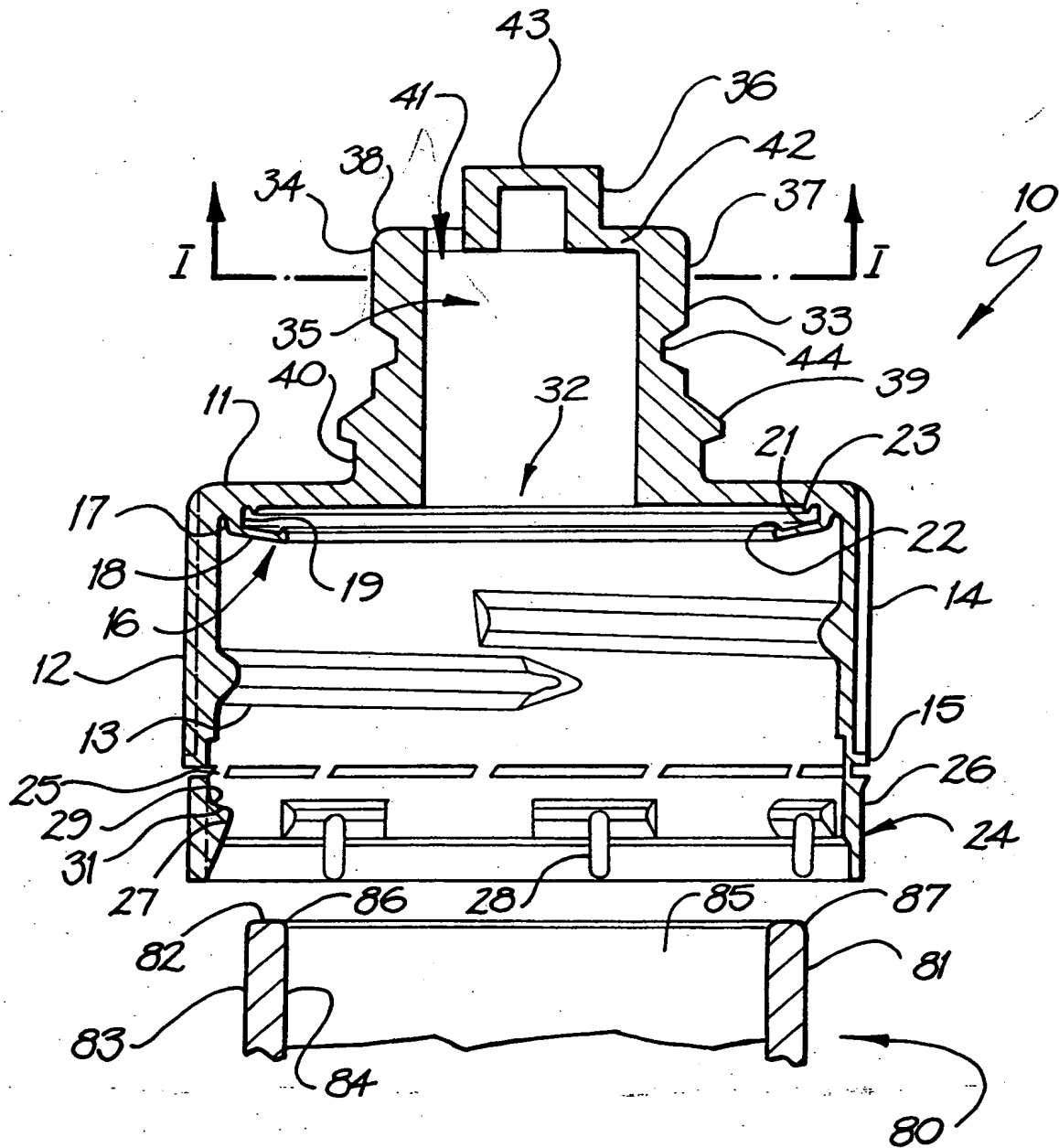


FIG. 1a

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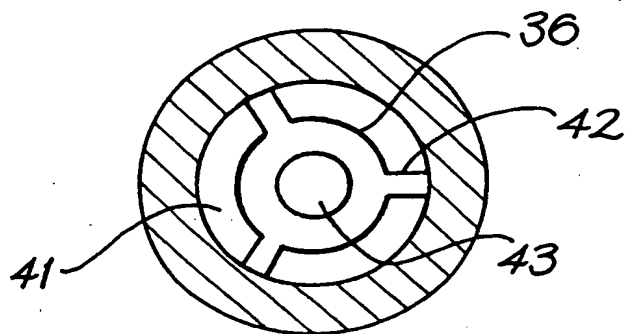


FIG. 1b

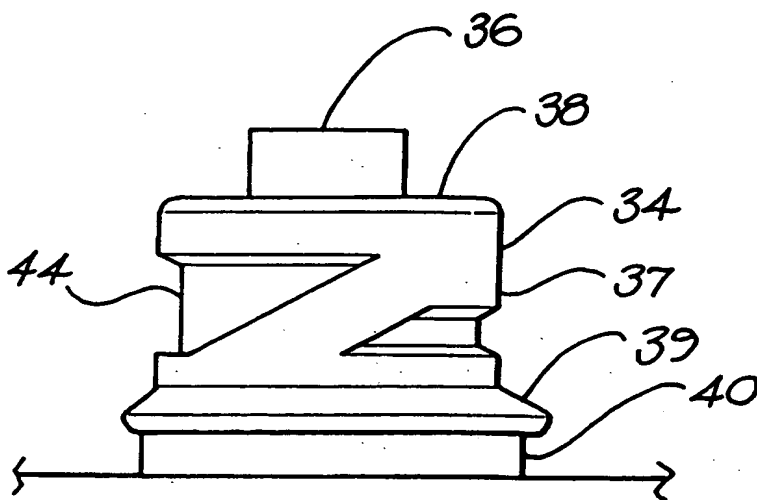


FIG. 2a

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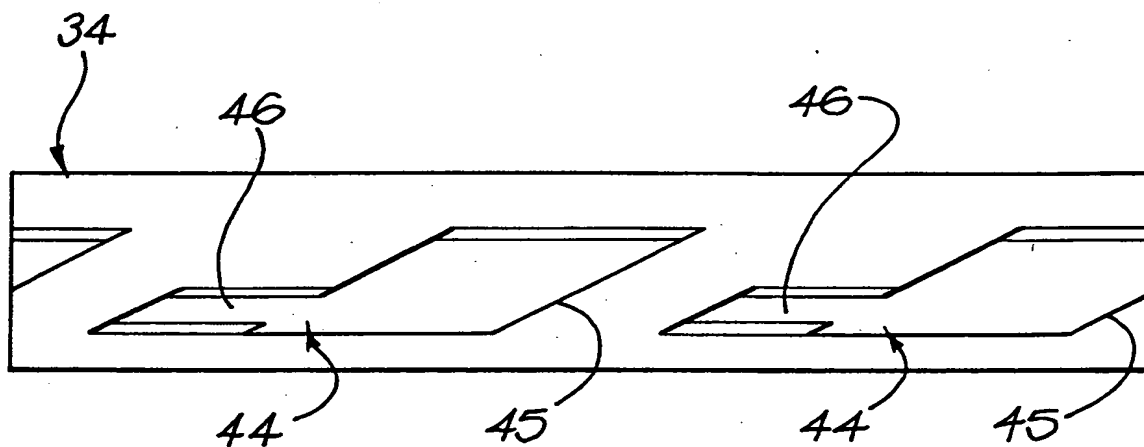


FIG. 2b

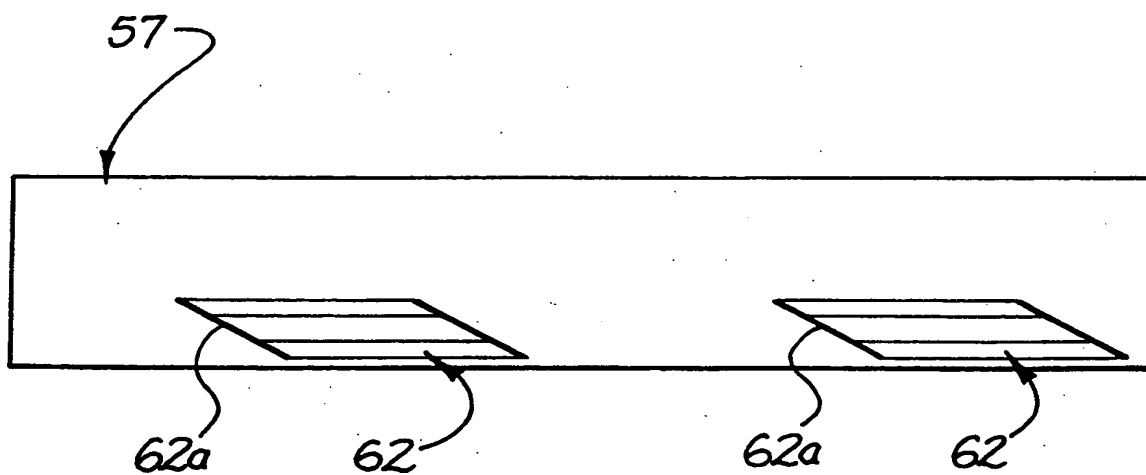


FIG. 3b

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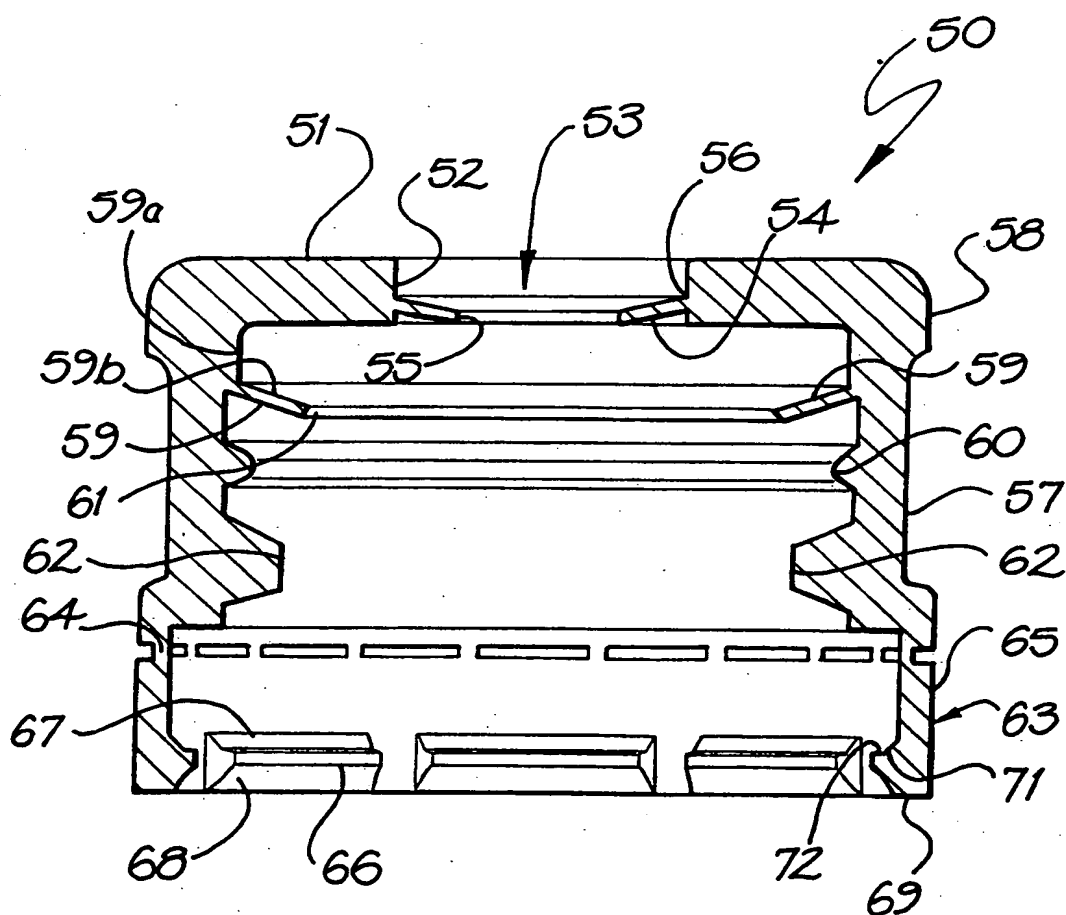


FIG. 3a

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00353

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl. ⁷ : B65D 47/20, 51/18,		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B65D 47/-, B65D 51/18		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT: (seal or reseal) and (skirt) and (plug or stopper or bung or spout)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5810185 A (GROESBECK) 22 September 1998 See whole document	1-36
X	WO 9855368 A (ERIE COUNTY PLASTICS CORPORATION) 10 December 1998 See whole document	1-36
A	US 4867354 A (SCHREIBER) 19 September 1989 See whole document	1-36
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 19 June 2000		Date of mailing of the international search report 04 JUL 2000
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929		Authorized officer KARYN MURRAY Telephone No : (02) 6283 2510

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU00/00353

C (Continuation).

DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5328063 A (BECK) 12 July 1994 See whole document	1-36

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU00/00353

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report			Patent Family Member			
US	5810185	NONE				
WO	9855368	AU	78228/98	US	5975369	
US	4867354	CA	2003875			
US	5328063	AU	71050/94	CA	2163863	WO 9429216
						END OF ANNEX